We know that greenhouse gases, like CO_2, warm the planet, and we even know how much, but what about aerosols? "When you burn fossil fuels," explains Manvendra Dubey of Los Alamos’ Earth and Environmental Sciences Division, "you emit not only CO_2, but also sulfur dioxide (SO_2), which becomes sulfate aerosols. Sulfates, along with some other aerosols, cool the planet by reflecting sunlight away." In the 1970s and 80s, before smokestacks were equipped to scrub sulfur, industry produced so much sulfate pollution that the resultant cooling counteracted the warming of greenhouse gases. But health concerns over particulate pollution and acid rain brought about the Clean Air Act, which forced industry to reduce sulfate emissions and ironically allowed the greenhouse effect to intensify. "Because we succeeded in reducing sulfate pollution," says Dubey, "we must now work twice as hard to control CO_2."

So if, as we learned with the sulfates, aerosols cool the planet, all we need to do is figure out how much and plug that number into climate models, right? Unfortunately, the problem is not so black and white—literally. Some aerosols, like sulfates and sea salt particles, may cool because they’re white and reflect sunlight, but other aerosols, such as black carbon (soot), are dark and absorb sunlight like a black shirt on a hot summer day. When they all mix into one giant atmospheric pointillist painting, you get shades of gray whose effects are hard to quantify. But scientists are working to measure the amount of light reflected and absorbed by the aerosol mix—what they call "aerosol optical depth" (AOD). AOD is the key parameter in determining the elusive radiative-forcing number needed for precise climate predictions.